Tutoriel Work of Chapter 3: Junction Field Effect Transistor

Exercise N° 1

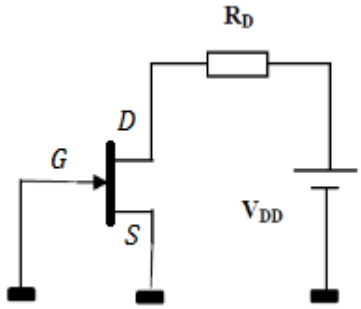
1- What type of unipolar transistor is used in the circuit shown opposite?

2- Give the value of the drain current I_D.

3- Determine the minimum value of V_{DD} to operate the transistor in the constant current region

4- What is the value of the drain current if $V_{DD} > 15V$?

5- Give the value of the voltage V_{DS} if $V_{DD} = 15V$

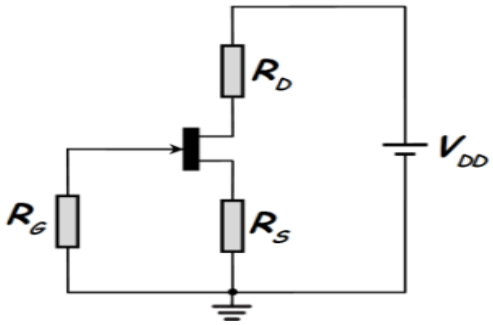


We give $R_D = 560\Omega$; $V_{Goff} = -4V$ *and* $I_{DSS} = 12mA$

Exercise N°2

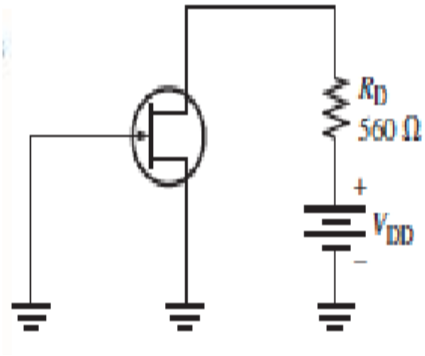
Consider the circuit shown in the figure below, where V_{DD}= 50V ; V_{DS}=25V ; V_{GS}=-1V and I_D=1.5 mA

Calculate R_D and R_S



Exercise N°3

1- For the JFET in Figure below, $V_{GS(off)} = -4\,V$ and $I_{DSS} = 12\,mA$. Determine the minimum value of V_{DD} required to put the device in the constant-current region of operation when V_{GS} = 0 V.



2- The datasheet for a 2N5459 JFET indicates that typically $I_{DSS} = 9\,mA$ and $V_{GS(off)} = -8V$ (maximum). Using these values, determine the drain current for $V_{GS} = 0V, -1V\ and\ -4V$.

3- The following information in included on the data sheet for a 2N5457 JFET: typically I_{DSS} = 3mA, $V_{GS(off)}$ = -6V maximum, and g_{fs}(max) = 5000µS. Using these values, determine the forward transconductance for V_{GS} = -4V and find I_D for this point.

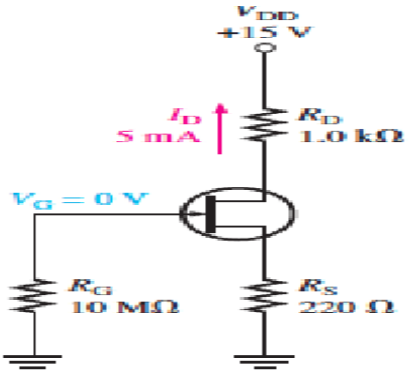
Exercise N°4

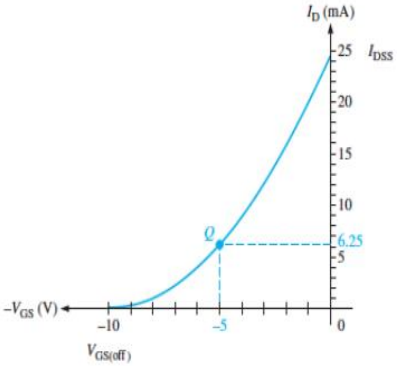
For the particular JFET in this circuit, the parameter values such as g_m, V_{GSoff}, and I_{DSS} are such that a drain current $\mathbf{I_D}$ of approximately **5 mA** is produced. Another JFET, even of the same type, may not produce the same results when connected in this circuit due to the variations in parameter values.

1- Determine the biasing method used in the circuit

2- Find V_{DS} and V_{GS}

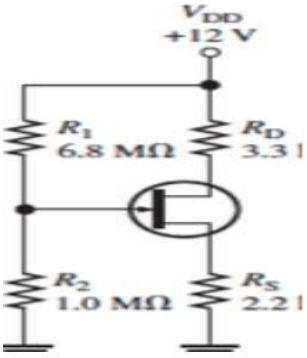
3- Determine the value of R_S required to self-bias an n-channel JFET that has the transfer characteristic curve shown in Figure below at V_{GS} = -5 V





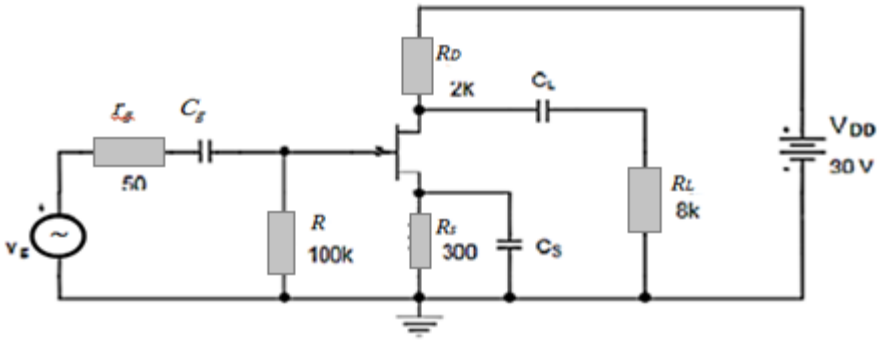
Exercise N°5

Determine I_D and V_{GS} for the JFET with voltage-divider bias in Figure below, given that for this particular JFET the parameter values are such that V_D = 7 V.



Exercise N°6

1. What type of circuit is shown in the diagram below?
2. Give the equivalent DC diagram. What type of bias is used?
3. Determine the operating point of the transistor.
4. Give the equivalent diagram for the dynamic small-signal regime (let $r_{DS} = \infty$).
5. Evaluate the g_m parameter of the transistor model.
6. Calculate the input impedance, output impedance, voltage gain and power gain.



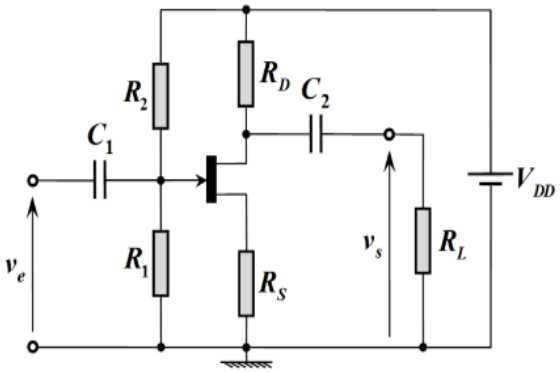
Exercise N°7

Consider the following circuit:

Given: $V_{DD} = 12V, V_{GSoff} = -3V;\ I_{DSS} = 9mA$;

$$g_m = 3.48\ mA/V, \rho^{-1} = 0$$

$R_2 = 4.7M\Omega$ and $R_D = R_S = R_L = 1K\Omega$

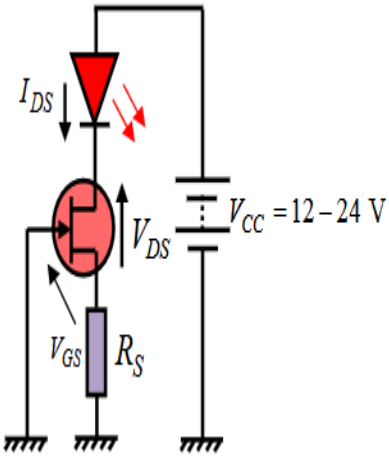


1- What value should be given to R1 so that the quiescent point of the transistor is located in the middle of the static load line?

2- Calculate the voltage gain and the input and output impedances.

Exercise N°8

We want to power an LED (light-emitting diode) at constant current ($10\ mA$) with a voltage source V_{CC} which can vary between $12\ V$ and $24\ V$. To do this we use a JFET transistor (BF245C) ($I_{DSS} = 17\ mA$) (which is sufficient to supply 10 mA). For $I_D = 10\ mA$, constant voltage $V_{GS} = -1{,}6\ V$. The JFET operating as a current source as soon as $V_{DS} > 4$ V



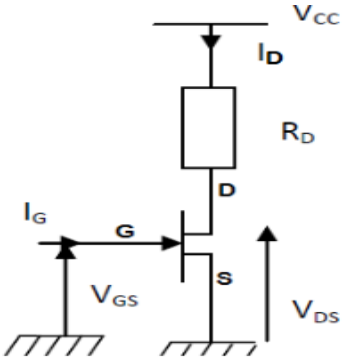
1. Calculate the value of the resistor R_S.
2. Calculate the minimum V_{CC} required for a current of 10 mA.

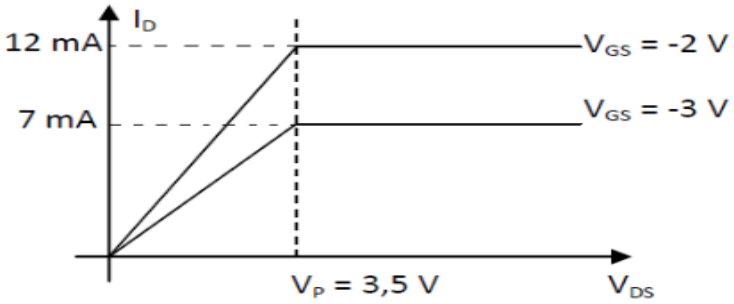
The voltage across the LED is given as 2 V for 10 mA.

3. The transistor Data Sheet indicates that P=300 mW, check that there is no problem with the transistor overheating.

Exercise N°9

Consider an N-channel junction field effect transistor (N-JFET) whose polarisation and characteristic network are shown in the following figure:





Check whether this transistor is biased in its ohmic zone or in its saturation zone in the following 3 cases:

- R_D = 100 Ω and V_{GS} = -2V.
- R_D = 3 KΩ and V_{GS} = -2V.
- R_D = 1 KΩ and V_{GS} = -3V.

$V_{CC} = 15$